

Application procedures for Public Offering of Technical Ideas

R&D program for Advanced Instrumentation System
for Severe Accidents in Nuclear Power Plant

"Safety Enhancement for LWRs" program in FY2012

(Rev.0)

Jun 29, 2012

Hitachi-GE Nuclear Energy, Ltd.
TOSHIBA CORPORATION
Mitsubishi Heavy Industries, Ltd.

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Instrumentation systems in the Nuclear Power Plant are very important system to monitor plant conditions for safety operation and shutdown. TEPCO's Fukushima Daiichi Nuclear Power Station Accident (TEPCO's Fukushima Daiichi Accident) caused severe accident such as severe core damage and loss of function of instrumentation systems.

An R&D program for Advanced Instrumentation System for Severe Accidents in Nuclear Power Plant (the R&D) is carried out as a result of public offering by the Agency for Natural Resources and Energy. In the R&D, we, Japanese nuclear power plant manufacturers (Hitachi-GE Nuclear Energy, Ltd., TOSHIBA CORPORATION, Mitsubishi Heavy Industries, Ltd.) aim to contribute to restrain accident from turning to severe accident such as TEPCO's Fukushima Daiichi Accident. For that purpose, we summarize specifications of existing instrumentation systems during the severe accident that takes into TEPCO's Fukushima Daiichi Accident. And we investigate and develop new instrumentation systems that is able to measure important parameters (e.g., water level, pressure, hydrogen concentration, etc.) in Nuclear Power Plant during severe accident.

And, in the R&D, we plan to enhance technical level in the nuclear industry in Japan and promote using nuclear power plant.

This time, we hold a "Public Offering of Technical Ideas" to accept ideas widely from industries besides the nuclear industry.

2.Points for "Public Offering of Technical Ideas"

In the R&D, we select monitoring parameters that are needed to monitor in severe accident, make development plans for each monitoring parameter, and develop new instrumentation systems.

These development of new instrumentation systems are planned to be carried out by us. However, we plan "Public Offering of Technical Ideas" for monitoring parameters that is technologically hard to develop.

This time, we select "**Hydrogen Gas Monitor**" for parameter that we consider to be hard technologically to develop, and we hold "Public Offering of Technical Ideas" about it.

At first, we decide draft selection result about adoption/rejection of applicant's proposal according to the evaluation method decided beforehand.

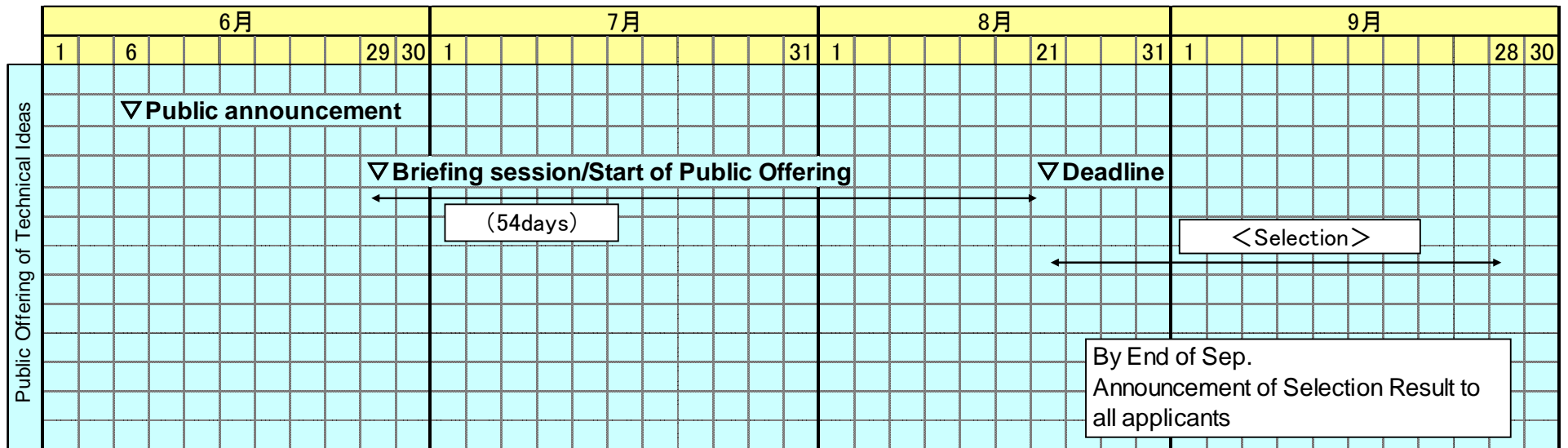
After that, councils (e.g., Advisory Committee) discuss whether evaluation about draft selection result is properly done according to the evaluation method or not. And finally, selection result is approved.

At the appearance of an idea that is feasible to the R&D, we adopt applicant's proposal as nomination to develop including us, and investigate a development plan in the R&D.

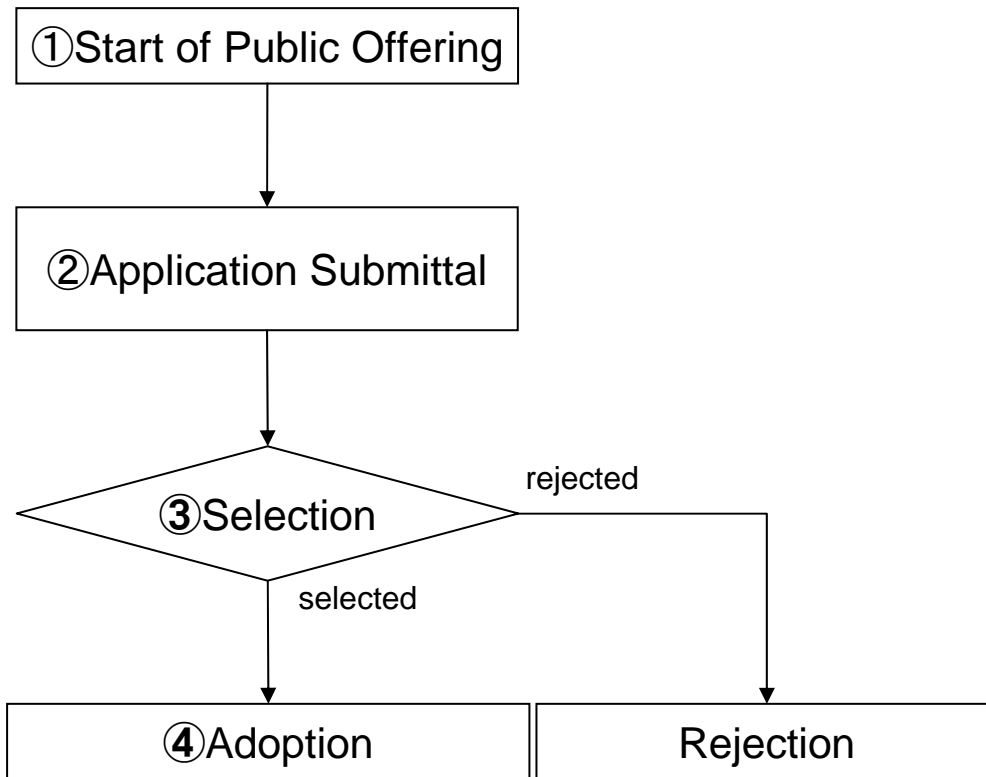
And if development plan with applicant's proposal is carried out, we plan to make a process not to impose a burden on applicant.

4. Schedule

The schedule of "Public Offering of Technical Ideas" is shown below.



The selection process of "Public Offering of Technical Ideas" is shown below.



- ① We make public announcement and start of Public Offering.
- ② Applicants prepare proposal and supporting document, and email them to us.
- ③ We evaluate applicant's proposal.
- ④ We adopt applicant's proposal as a nomination to develop.

➤Parameters for "Public Offering of Technical Ideas"

We expect your technical idea about "**Hydrogen Gas Monitor.**"

"Hydrogen Gas Monitor" is one of instrumentation systems that we plan to develop and confirm in the R&D.

Parameters for "Public Offering of Technical Ideas" are shown below.

•Hydrogen Gas Monitor

- 1) hydrogen concentration in D/W※ or S/C※
- 2) hydrogen concentration in R/B※
- 3) hydrogen concentration in CV※
- 4) hydrogen concentration in Annulus

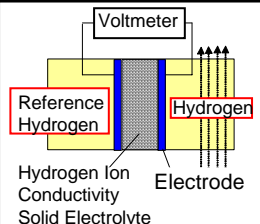
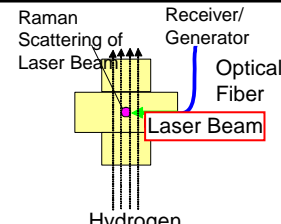
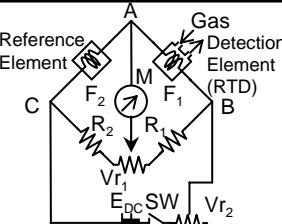
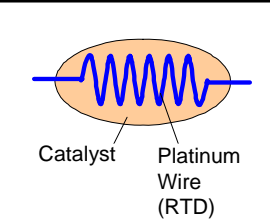
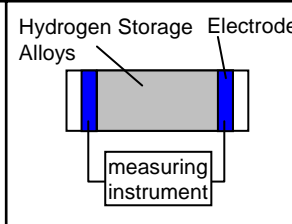
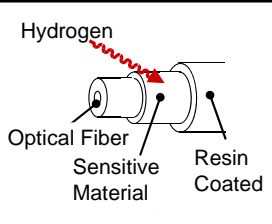
※ D/W: Drywell
S/C: Suppression Chamber
R/B: Reactor Building
CV: Containment Vessel
(Please refer to section 14:Glossary)

Our investigation results about evaluation and problem of measurement methods for parameters for "Public Offering of Technical Ideas" are shown next pages 9-14.

6.Parameters for Public Offering of Technical Ideas (2/9) 9

➤ Investigation results (summary)

Our investigation results summary about measurement methods is shown below. (Please refer to next slide about "category.")

	Proto Conductivity Solid Electrolyte	Laser Raman	Thermal Conduction	Catalytic Combustion	Hydrogen Storage Alloys	Optical Fiber
Outline						
Measurement Principle	It measures electromotive force occurred by difference of hydrogen concentration.	It measures Raman scattering of laser beam by molecular hydrogen. It analyzes light emitted by molecular vibration.	It measures temperature change of detecting element occurred by difference of thermal conductivity of gas.	It measures temperature change by reaction at catalyst surface by hydrogen in gas.	It measures change in resistance by hydrogen storage alloys.	It measures change of hydrogen storage in sensitive material.
Evaluation	○ It is available under condition of 500 deg C and during the severe accident. It has simple structure and radiation resistance.	△ It has verification results as an Optical Fiber under condition of 200 deg C and 1MGy. There is a probability to be available during the severe accident. <u>It needs to maintain Laser-Receiver/Generator in operation frequently, so it is unsuitable to apply to the existing Nuclear Power Plants.</u>	△ There is a probability to be available under condition of 200 deg C It needs to make the amount of flowing sample gas constant. There are problems about <u>sampling method considering effect of temperature, pressure, etc. during the severe accident and responsibility.</u>	△ <u>It needs to investigate quantitative measurement method during the severe accident.</u> In general, it isn't likely to be affected by temperature, but it needs to <u>verify applicability during the severe accident.</u>	○ It is available under condition of high temperature. It has simple structure and it is conceivable to have environmental resistance. It needs to verify applicability during the severe accident.	△ It is able to measure at multipoint. It has high safety by optical measurement method. <u>It needs to verify maintainability and applicability during the severe accident.</u>
Category	Category-1 <nomination>	Category-2	Category-2	Category-2	Category-1 <nomination>	Category-2

○:Development point and test requirement to implement are clear.

△:There is a probability to be available during the severe accident, but there are a lot of problems to be solved.

6.Parameters for Public Offering of Technical Ideas (3/9) 10

➤ Category of Measurement methods

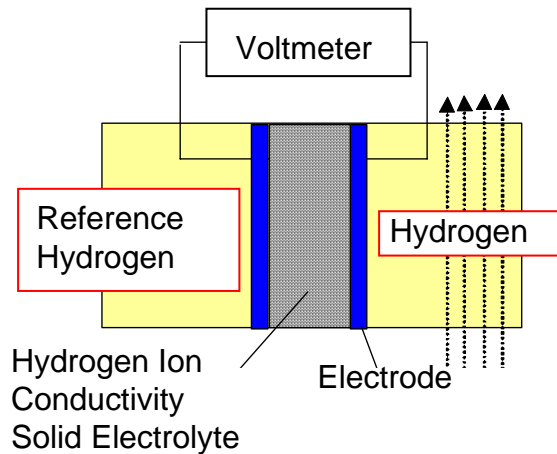
Category	Explanation	Collection of Ideas
Category-1	It is measurement method that we plan to develop. <u>Development point and test requirement to implement are clear.</u>	We plan to develop. <u>So, in this "Public Offering of Technical Ideas", we don't expect technical idea basically.</u>
Category-2	<u>There is a probability to be available during the severe accident, but there are a lot of problems to be solved.</u> So, ideas in Category-2 are next to ideas in Category-1.	<u>We expect a technical idea that can solve problems in our evaluation and satisfy specification for parameter.</u> ex.) • Measurement method that is using Laser Raman and has good maintainability, etc.
Category-3	Ideas are not mentioned in this document.	<u>We expect a measurement method that satisfy specification for parameter.</u>

➤ Collection of Ideas

We expect your technical idea in **Category-2 or Category-3 about hydrogen concentration in D/W or S/C, in R/B, in CV or in Annulus.**

<Proton Conductivity Solid Electrolyte>

•Outline



•Measurement Principle

-It measures electromotive force occurred by difference of hydrogen concentration.

•Evaluation : ○(Development point and test requirement to implement are clear.)

-It is available under condition of 500 deg C and during the severe accident.

-It has simple structure and radiation resistance.

•Problem

-It needs to verify environmental resistance of sealing method to seal reference hydrogen, necessary for measurement.

-It needs to verify feasibility of system configuration during the severe accident in which temperature and pressure change.

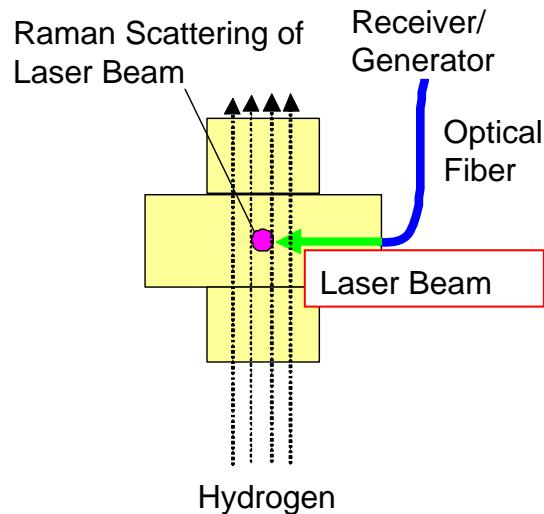
-It needs to verify and improve mechanical strength of components.

•Category

Category-1 <nomination>

<Laser Raman>

•Outline



•Measurement Principle

- It measures Raman scattering of laser beam by molecular hydrogen.
- It analyzes light emitted by molecular vibration.

•Evaluation : Δ (There is a probability to be available during the severe accident, but there are a lot of problems to be solved.)

- It has verification results as an Optical Fiber under condition of 200 deg C and 1MGy. There is a probability to be available during the severe accident.

•Problem

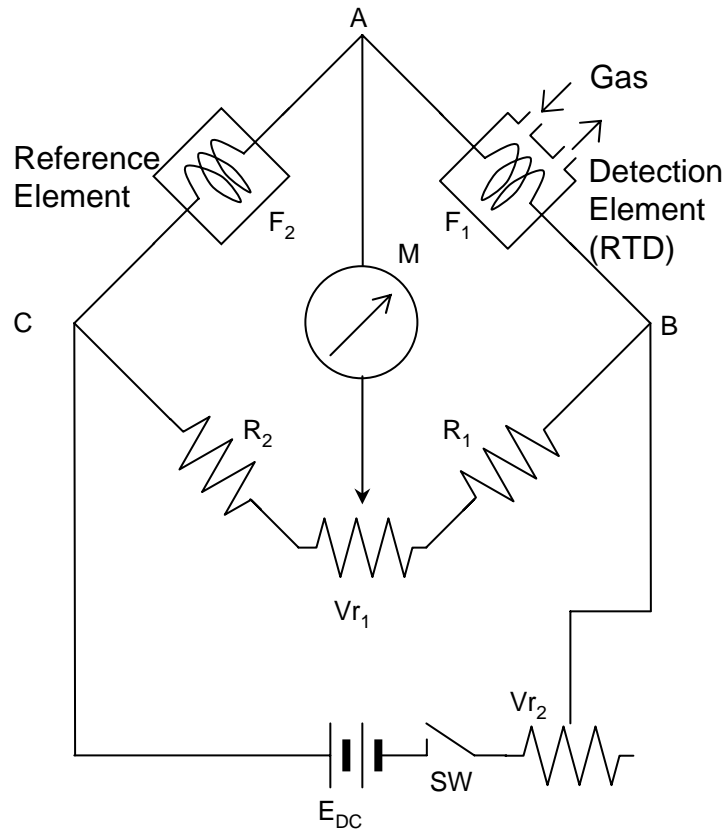
- It needs optical fiber, which is able to be installed under high temperature condition (200deg C).
- It needs measure for effect of scattering of light by moisture.
- It needs measure to prevent condensation at optical system.
- It needs to satisfy seismic resistance of optical system.
- It needs to satisfy radiation resistance of whole system.
- It needs to maintain Laser-Receiver/Generator in operation frequently, so it is unsuitable to apply to the existing Nuclear Power Plants.
- It needs to verify feasibility of system configuration during the severe accident in which temperature and pressure change.

•Category

Category-2

<Thermal Conduction>

•Outline



•Measurement Principle

-It measures temperature change of detecting element occurred by difference of thermal conductivity of gas.

•Evaluation: Δ (There is a probability to be available during the severe accident, but there are a lot of problems to be solved.)

-There is a probability to be available under condition of 200 deg C.

•Problem

-It needs to make the amount of flowing sample gas constant. There are problems about sampling method considering effect of temperature, pressure, etc. during the severe accident and responsibility. The existing sampling method didn't work in TEPCO's Fukushima Daiichi Accident because of loss of power supply and loss of cooling water source. So, it needs to consider power saving system and system without cooling water.

-It needs compensation of humidity and measure to prevent condensation.

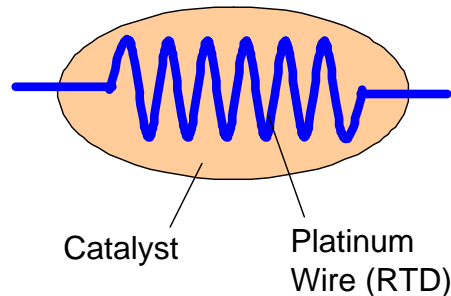
-It needs to verify feasibility of system configuration during the severe accident in which temperature and pressure change.

•Category

Category-2

<Catalytic Combustion>

▪ Outline



▪ Measurement Principle

-It measures temperature change by reaction at catalyst surface by hydrogen in gas.

▪ Evaluation : Δ (There is a probability to be available during the severe accident, but there are a lot of problems to be solved.)

-In general, it isn't likely to be affected by temperature.

▪ Problem

-It needs oxygen in gas for measuring. But it can't be used at Boiling Water Reactor (BWR) Nuclear Power Plants, because containment vessel is filled with nitrogen.

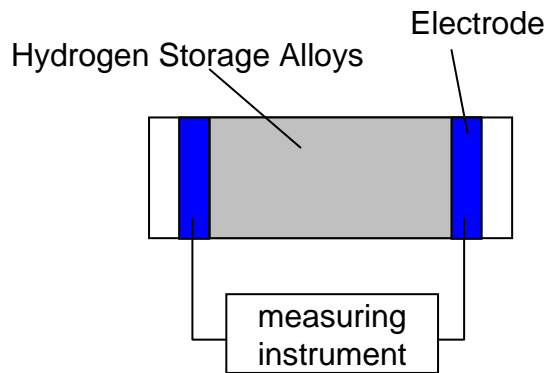
-It needs to verify feasibility of system configuration during the severe accident in which temperature and pressure change.

▪ Category

Category-2

<Hydrogen Storage Alloys>

•Outline



▪ Measurement Principle

-It measures change in resistance by hydrogen storage alloys.

▪ Evaluation : ○(Development point and test requirement to implement are clear.)

-It has simple structure and it is conceivable to have environmental resistance.

▪ Problem

-It needs to verify function under high temperature condition and evaluate effect by moisture.

-It needs to investigate sensor and connection part suitable for the severe accident condition.

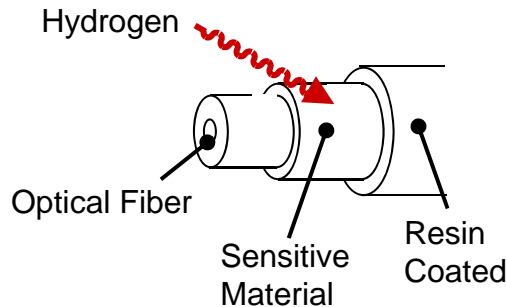
-It needs to verify feasibility of system configuration during the severe accident in which temperature and pressure change.

▪ Category

Category-1 <nomination>

<Optical Fiber>

•Outline



•Measurement Principle

-It measures change of hydrogen storage in sensitive material.

•Evaluation : Δ (There is a probability to be available during the severe accident, but there are a lot of problems to be solved.)

-It is able to measure at multipoint by one optical fiber. It has high safety by optical measurement method.

-Thermal resistance of the existing resin coated is about 300 deg C So, to satisfy thermal resistance specification, it needs to develop a new material and it is hard to complete it by the end of the R&D term.

•Problem

-It needs to valuate effect by high temperature and moisture.

-It needs to investigate sensor configuration and manufacturing method suitable for the severe accident condition.

-It needs to verify maintainability and feasibility of system configuration during the severe accident in which temperature and pressure change.

•Category

Category-2

➤ Specification for parameter

Specification for parameter is shown next page.

- 1) hydrogen concentration in D/W or S/C
- 2) hydrogen concentration in R/B
- 3) hydrogen concentration in CV
- 4) hydrogen concentration in Annulus

CAUTION:

- Contents in "Points of attention" are shown for example and requirements have to be taken into consideration to apply to the existing Nuclear Power Plants.
- In proposal for "Public Offering of Technical Ideas", **it DOESN'T NEED to satisfy contents in "Points of attention."**
- But if your proposal satisfy some requirements in "Points of attention", please explain about it in supporting document. We will treat it as **additional points in selection process**.

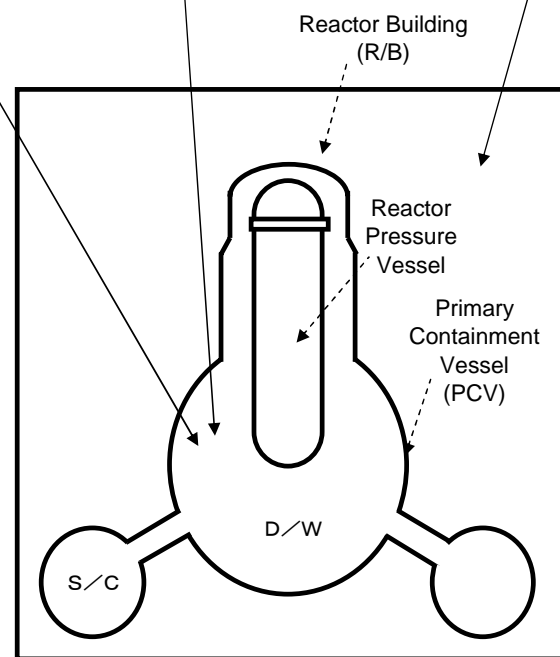
7. Specification for Parameter (2/2)

Specification for "Hydrogen Gas Monitor" in "Public Offering of Technical Ideas"

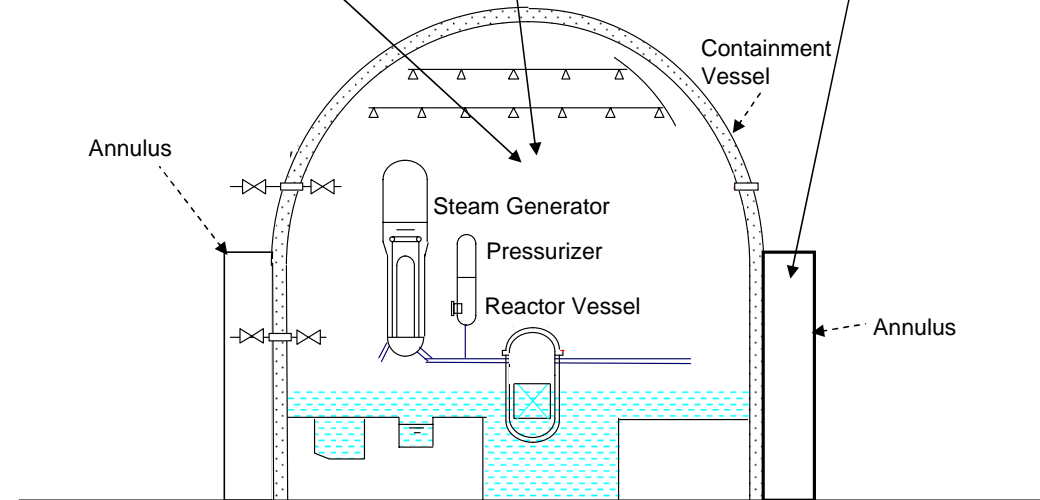
R&D program for Advanced Instrumentation System for Severe Accidents in Nuclear Power Plant

Parameters		No.1	No.2	No.3	No.4	No.5	No.6
Condition of object to monitor		Density of Hydrogen in D/W or S/C part1	Density of Hydrogen in D/W or S/C part2	Density of Hydrogen in R/B	Density of Hydrogen in CV part1	Density of Hydrogen in CV part2	Density of Hydrogen in Annulus
Kind of fluid	Kind of fluid	moisture,hydrogen,nitrogen	moisture,hydrogen,nitrogen	moisture,hydrogen,air	moisture,hydrogen,air	moisture,hydrogen,air	moisture,hydrogen,air
	Temperature of fluid	10~300°C(in PCV)	10~700°C(in PCV)	10~100°C	10~300°C	10~200°C	10~100°C
	Pressure of fluid (gauge pressure)	0~1MPa(in PCV)	0~1MPa(in PCV)	0~0.01MPa	0~1.6MPa	0~1.6MPa	0~0.01MPa
Environmental condition to set up equipment	Temperature	10~300°C(in PCV)*1 10~66°C(in R/B)*1	10~700°C(in PCV)*1 10~100°C(in R/B)*1	10~100°C	10~300°C	10~200°C	10~100°C
	Relative humidity	10~100%RH	10~100%RH	10~100%RH	10~100%RH	10~100%RH	10~100%RH
	Pressure (gauge pressure)	0~1MPa(in PCV)*1 0~0.01MPa(in R/B)*1	0~1MPa(in PCV)*1 0~0.01MPa(in R/B)*1	0~0.01MPa	0~1.6MPa	0~1.6MPa	0~0.01MPa
Monitoring condition	Radiation	It should have Radiation resistance. (total dose:5x10^6Gy (in PCV))*1 (total dose:3x10^5Gy (in R/B))*1	It should have Radiation resistance. (total dose:5x10^6Gy (in PCV))*1 (total dose:2x10^6Gy (in R/B))*1	It should have Radiation resistance. (total dose:2x10^6Gy(in R/B))	It should have Radiation resistance. (total dose:2x10^6Gy)	It should have Radiation resistance. (total dose:2x10^6Gy)	It should have Radiation resistance. (total dose:5x10^6Gy)
	Measuring range	0~20%	0~20%	It should detect whether density of hydrogen is 4% or more/less.	0~20%	0~20%	0~20%
	Accuracy	±1% or less as density of hydrogen	±1% or less as density of hydrogen	±1% or less as density of hydrogen	±1% or less as density of hydrogen	±1% or less as density of hydrogen	±1% or less as density of hydrogen *2
Points of attention	Response time	within 10 min. (target)	within 10 min. (target)	within 10 min. (target)	within 10 min. (target)	within 10 min. (target)	within 10 min. (target)
	-Contents in "Points of attention" are shown for example and requirements have to be taken into consideration to apply to the existing Nuclear Power Plants. -In proposal for "Public Offering of Technical Ideas", it DOESN'T NEED to satisfy contents in "Points of attention." -But if your proposal satisfy some requirements in "Points of attention", please <u>explain about it in supporting document</u> . We will treat it as additional points in selection process .	It is desirable to be water resistant.	It is desirable to be water resistant.	It is desirable to be water resistant.	It is desirable to be water resistant.	It is desirable to be water resistant.	It is desirable to be water resistant.
		It is desirable to be seismic resistant.	It is desirable to be seismic resistant.	It is desirable to be seismic resistant.	It is desirable to be seismic resistant.	It is desirable to be seismic resistant.	It is desirable to be seismic resistant.
It is desirable to be usable in saturated vapour.		It is desirable to be usable in saturated vapour.	It is desirable to be usable in saturated vapour.	It is desirable to be usable in saturated vapour.	It is desirable to be usable in saturated vapour.	It is desirable to be usable in saturated vapour.	
It is desirable to be usable more than 3 days under environmental condition (temperature, relative humidity and pressure).	It is desirable to be usable more than 3 days under environmental condition (temperature, relative humidity and pressure).	It is desirable to be usable more than 3 days under environmental condition (temperature, relative humidity and pressure).	It is desirable to be usable more than 3 days under environmental condition (temperature, relative humidity and pressure).	It is desirable to be usable more than 3 days under environmental condition (temperature, relative humidity and pressure).	It is desirable to be usable more than 3 days under environmental condition (temperature, relative humidity and pressure).	It is desirable to be usable more than 3 days under environmental condition (temperature, relative humidity and pressure).	
	It is desirable to be resistant to SOx under high temperature condition.	It is desirable to be resistant to SOx under high temperature condition.	It is desirable to be resistant to SOx under high temperature condition.	It is desirable to be resistant to SOx under high temperature condition.	It is desirable to be resistant to SOx under high temperature condition.	It is desirable to be resistant to SOx under high temperature condition.	
	It is desirable to monitor object even if it includes "iodine."	It is desirable to monitor object even if it includes "iodine."	It is desirable to monitor object even if it includes "iodine."	It is desirable to monitor object even if it includes "iodine."	It is desirable to monitor object even if it includes "iodine."	It is desirable to monitor object even if it includes "iodine."	

*1:Please propose after consideration about "Environmental condition to set up equipment."
 *2:Measuring range accuracy shows density of hydrogen at dry conversion. Accutually, it is effected by moisture.
 *3:Response time means a delay time of whole system. (Time from detection of hydrogen to output or indication of density)



BWR Nuclear Power Plants

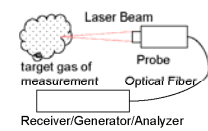


PWR Nuclear Power Plants

Please prepare your proposal by using a prescribed format.

Please attach supporting document, such as diagram, photo, test data, product catalog, patent gazette, etc. Paper size of supporting document is only A4 or A3.

Applicant can download "proposal format" at the web site of the Agency for Natural Resources and Energy after Jul. 2nd (Mon.).

Application procedures for Public Offering of Technical Ideas		No. _____
Proposal Format (example)		
(1) Information of proposer		
Corporate Name	—	
Proposer Name	Ichiro Keisou	
Address	〒○○○-○○○ ××-×○○-cho, △△, Japan	
Mail Address	ichiro.keisou@keisou.system.com	
TEL	999-9999-9999	Date Jun XX, 2012
(2) Proposal [Summary]		
Applicant Name (Corporate Name or Proposer Name)	Ichiro Keisou (Please show organization of measurement method by using figure.)	
Name of measurement method	Measurement method of hydrogen concentration by laser analysis	
Summary of measurement method	 <p>It measures hydrogen concentration by irradiating laser beam to target gas of measurement and analyzing scattered light.</p>	
(3) Proposal [Details]		
Parameters (Please check one or more applicable item)	<input type="checkbox"/> No.1 1) hydrogen concentration in D/W or S/C ver.1 <input type="checkbox"/> No.2 1) hydrogen concentration in D/W or S/C ver.2 <input type="checkbox"/> No.3 2) hydrogen concentration in R/B <input type="checkbox"/> No.4 3) hydrogen concentration in CV ver.1 <input type="checkbox"/> No.5 3) hydrogen concentration in CV ver.2 <input type="checkbox"/> No.6 4) hydrogen concentration in Annulus	
Principle of measurement	<p>It irradiates laser beam to target gas of measurement, and detects Raman scattering of laser beam (inelastic scattering) whose frequency differs from frequency of incident light by molecular vibration. It uses principle to specify material and determine the quantity of material by analyzing shifted frequency and strength of scattered light.</p> <p>Probe which irradiates laser beam and receives scattering light is located in target gas of measurement, and it is connected to laser receiver/generator and analyzer. It measures hydrogen concentration continuously by measuring shifted frequency and strength of scattered light by analyzer.</p>	
Reason for proposal	It is conceivable to be available because probe is made of material which has high environmental resistance and is not affected by other gas.	
Completeness of proposal (Please check each applicable item)	<input type="checkbox"/> Desk study was completed/is going on <input type="checkbox"/> Basic test was completed/is going on <input type="checkbox"/> Confirmation test was completed/is going on <input type="checkbox"/> Productization was completed/System application was completed	
Problem for productization and system application	Verification of radiation resistance Reduction of power consumption Verification of equipment's seismic resistance Improvement of maintainability of laser Receiver/Generator	
Necessary Costs for productization	for development : ¥*,**,**, for materials : ¥*,**,**, for test : ¥**,**	
Presence or absence of patent (Please check each applicable item)	<input type="checkbox"/> Absence <input type="checkbox"/> Presence →Application number, patent number, etc. [_____]	
Size	Probe: 50mm(W) × 50mm(D) × 300mm(L), Optical Fiber: 100m, Laser Receiver/Generator/Analyzer: 600mm(W) × 100mm(D) × 500mm(L)	
Material	Probe: SiO ₂ and SUS314, Optical Fiber : SiO ₂ , Housing of Laser Receiver/Generator/Analyzer: Al	
Mass	Total mass: less than about 30 kg	
Output signal	1~5V (Output of analyzer)	
Measuring range	0~20%	
Accuracy	less than ±0.5% for hydrogen concentration	
Response time	less than 30 sec	
Environmental condition	Temperature	-30~800°C
	Relative humidity	10~100%RH
	Pressure	0~1Mpa
	Radiation resistance	5*10 ⁶ Gy
Life time under the environmental condition	10days	
Seismic resistance	No verification data of equipment's seismic resistance	
Water resistance	Probe is water resistant by mechanical seal.	
Supporting document	Num. of page : __1__ sheet Content : __Function diagram of Measurement method of hydrogen concentration by laser analysis__	

※1: Please attach supporting document, such as diagram, photo, test data, product catalog, patent gazette, etc. Paper size of supporting document is only A4 or A3.

< Proposal Format > (example)

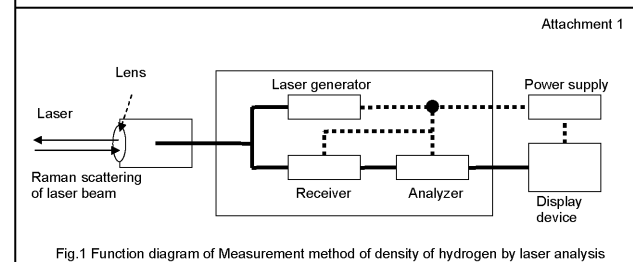
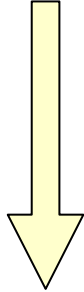


Fig.1 Function diagram of Measurement method of density of hydrogen by laser analysis

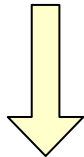
We will decide selection result about adoption/rejection of applicant's proposal according to the evaluation process shown below.

【STEP1】 Evaluating applicant's proposal



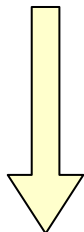
- We will evaluate each contents of applicant's proposal by evaluation points shown below.
 - Is applicant's proposal clear?
 - Is there high feasibility in applicant's proposal?
 - How is consideration about applicant's proposal proceeded?
 - Does applicant's proposal satisfy specification for parameter?
 - Does applicant's proposal satisfy specification in "Points of attention" (additional points) ? ,etc.

【STEP2】 Questionnaire and hearing



- We will ask a questionnaire about applicant's proposal, which becomes higher rank in STEP1.
- Before asking, we will make Memorandum of Understanding (MOU) about handling of technical information (including secret information) between applicant and us. After that, please answer our questions.
- We may ask a hearing about applicant's proposal and/or answers to our questionnaire.

【STEP3】 Evaluating answers to our questionnaire and results of hearing



- We will evaluate answers to our questionnaire and results of hearing by evaluation points shown below.
 - Is answers to our questionnaire clear?
 - Is a concern of applicant's proposal going to be solved?
 - How long does it take to complete its development?
 - Is applicant's proposal applicable to a Nuclear Power Plant? ,etc.

【STEP4】 Deciding draft selection result



- We will decide draft selection result according to results in STEP1 and 2.

【STEP5】 Deciding selection result

- Councils (e.g., Advisory Committee) will discuss whether evaluation about draft selection result is properly done according to each STEPs or not. And finally, selection result is approved.

Please email [your proposal](#) and [supporting document](#) by deadline. The addressee is shown below and deadline is shown next page.

CAUTION:

Please send one email per one proposal.

Attachment file size limit is **2MB**.

Attachment file formats are [Word for proposal](#) and [PDF for supporting document](#).

Addressee
t_idea@eis.iec.toshiba.co.jp
TOSHIBA CORPORATION

(TOSHIBA CORPORATION acts an addressee on behalf of promoters.)

➤ Deadline

15:00(JST) on Aug 21 (Tue.), 2012

➤ Announcement of Selection Result

Selection result will be announced by end of September to all applicants.
And we don't accept any inquiry about selection result basically.

➤ Handling of Applicant's Proposal

We handle contents of section (2) and (3) in proposal format in like manner as handling information that is open to public. (But we NEVER make them open to public without applicant's permission.)

In the case of adoption of applicant's proposal, contents of section (2) in the proposal format will be open to public for the purpose of notifying the result of "Public Offering of Technical Ideas".

➤ Promoter

Hitachi-GE Nuclear Energy, Ltd.
TOSHIBA CORPORATION
Mitsubishi Heavy Industries, Ltd.

➤ Applicant Requirements

There is no applicant requirement.

➤ Language in Proposal

Language in Proposal is ONLY Japanese or English.

➤ Private Information

Private information acquired by the application shall be used only for the purpose of "Public Offering of Technical Ideas."

➤ Copyright

Copyright used on or in connection with proposal of the applicant remains in such applicant.

However, we has the right to reproduce and publish the title and the abstract of such proposal without payment of any charge. If it's inconvenience with you, we coordinate individually.

➤ Incentive

If the proposal of the applicant is selected, there are possibilities to apply it to the existing Nuclear Power Plants in Japan, etc. About other incentives, we will discuss with such .

➤ Intellectual Property

Our policy about intellectual property developed through the research between the applicant and us is shown below.

Intellectual property developed individually by the applicant or us shall be owned by such applicant or us who develops such intellectual property, as the case may be.

Intellectual property developed jointly between the applicant and us shall be owned jointly between them.

If the proposal of the applicant that has already included intellectual property is selected, we will discuss with such applicant regarding the deal of such intellectual property including its ownership.

Explanation of the main technical terms is shown below.

Technical terms	Explanation
Containment Vessel (CV) [PWR] Primary Containment Vessel (PCV) [BWR]	Containment Vessel/Primary Containment Vessel is a vessel, made of steel, that covers important instruments (e.g., Reactor Pressure Vessel, pump, etc.).
Drywell (D/W) [BWR only]	Drywell is a part of primary containment vessel of Boiling Water Reactor (BWR) Nuclear Power Plants. It contains cooling water discharged from a tube under accident condition (e.g., rupture of the first cooling water tube).
Suppression Chamber (S/C) [BWR only]	Suppression Chamber is a facilities in BWR Nuclear Power Plants that contains water ordinarily. In case of accident that a cooling water in Reactor Pressure Vessel decreases and steam pressure rises, it makes pressure in Reactor Pressure Vessel lower by cooling steam. And it is a water source of Emergency Core Cooling System (ECCS).
Reactor Building (R/B) [BWR only]	Reactor Building is a building that contains Containment Vessel/Primary Containment Vessel and other reactor facilities. In Reactor Building of BWR Nuclear Power Plants , it keeps negative pressure inside building to prevent radioactive materials from being released outside building under accident condition. (In Pressurized Water Reactor (PWR) Nuclear Power Plants, it keeps negative pressure inside annulus written below.)
Annulus [PWR only]	In PWR Nuclear Power Plants, Annulus is interspaces with few meter width between a containment vessel and an external shielding building (external shielding wall). In case of gas leakage from a containment vessel, annulus prevents gas from leaking directly to an external atmosphere with using annulus air cleanup systems.

(1) Information of proposer

Corporate Name	—		
Proposer Name	Ichiro Keisou		
Address	〒○○○-○○○○ ××-× □□□-cho, △△, Japan		
Mail Address	ichiro.keisou@keisou.system.com		
TEL	9 9 9 - 9 9 9 9 - 9 9 9 9	Date	Jun X X, 2012

(2) Proposal [Summary]

Applicant Name (Corporate Name or Proposer Name)	Ichiro Keisou	Organization (Please show organization of measurement method by using figure.)
Name of measurement method	Measurement method of hydrogen concentration by laser analysis	
Summary of measurement method	It measures hydrogen concentration by irradiating laser beam to target gas of measurement and analyzing scattered light.	

(3) Proposal [Details]

Parameters (Please check one or more applicable item)	<input type="checkbox"/> No.1 1) hydrogen concentration in D/W or S/C ver.1 <input type="checkbox"/> No.2 1) hydrogen concentration in D/W or S/C ver.2 <input type="checkbox"/> No.3 2) hydrogen concentration in R/B <input type="checkbox"/> No.4 3) hydrogen concentration in CV ver.1 <input type="checkbox"/> No.5 3) hydrogen concentration in CV ver.2 <input type="checkbox"/> No.6 4) hydrogen concentration in Annulus
Principle of measurement	It irradiates laser beam to target gas of measurement, and detects Raman scattering of laser beam (inelastic scattering) whose frequency differs from frequency of incident light by molecular vibration. It uses principle to specify material and determine the quantity of material by analyzing shifted frequency and strength of scattered light. Probe which irradiates laser beam and receives scattering light is located in target gas of measurement, and it is connected to laser receiver/generator and analyzer. It measures hydrogen concentration continuously by measuring shifted frequency and strength of scattered light by analyzer.
Reason for proposal	It is conceivable to be available because probe is made of material which has high environmental resistance and is not affected by other gas.

Completeness of proposal (Please check each applicable item)	<input type="checkbox"/> Desk study was completed/is going on <input type="checkbox"/> Basic test was completed/is going on <input type="checkbox"/> Confirmation test was completed/is going on <input type="checkbox"/> Productization was completed/System application was completed	
Problem for productization and system application	Verification of radiation resistance Reduction of power consumption Verification of equipment's seismic resistance Improvement of maintainability of laser Receiver/Generator	
Necessary Costs for productization	for development : ¥*, ***, ***, for materials : ¥*, ***, ***, for test : ¥***, ***	
Presence or absence of patent (Please check each applicable item)	<input type="checkbox"/> Absence <input type="checkbox"/> Presence →Application number, patent number, etc. [_____]	
Size	Probe: 50mm(W) × 50mm(D) × 300mm(L), Optical Fiber: 100m, Laser Receiver/Generator/Analyzer: 600mm(W) × 100mm(D) × 500mm(L)	
Material	Probe: SiO ₂ and SUS314, Optical Fiber : SiO ₂ Housing of Laser Receiver/Generator/Analyzer: Al	
Mass	Total mass: less than about 30 kg	
Output signal	1~5V (Output of analyzer)	
Measuring range	0~20%	
Accuracy	less than ±0.5% for hydrogen concentration	
Response time	less than 30 sec	
Environmental condition	Temperature	-30~800°C
	Relative humidity	10~100%RH
	Pressure	0~1MPa
	Radiation resistance	5 × 10 ⁶ Gy
Life time under the environmental condition	10days	
Seismic resistance	No verification data of equipment's seismic resistance	
Water resistance	Probe is water resistant by mechanical seal.	
Supporting document	Num. of page : <u> 1 </u> sheet Content : <u> Function diagram of Measurement method of hydrogen concentration by laser analysis </u>	

※1: Please attach supporting document, such as diagram, photo, test data, product catalog, patent gazette, etc. Paper size of supporting document is only A4 or A3.

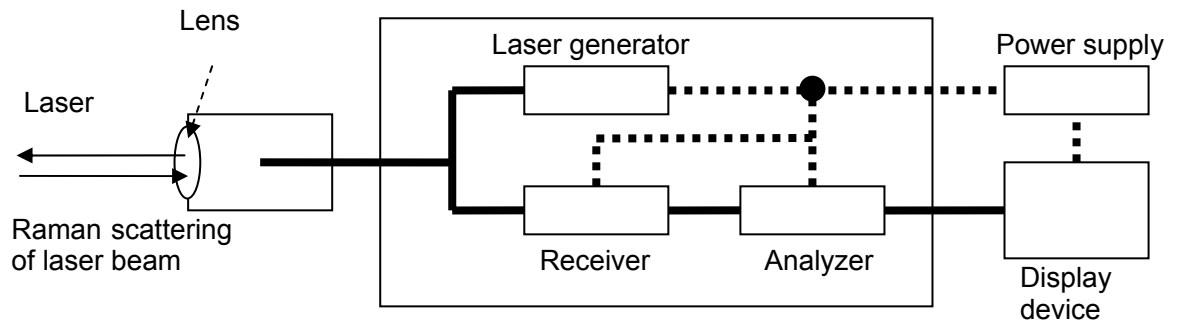


Fig.1 Function diagram of Measurement method of hydrogen concentration by laser

Thank you for your attention!